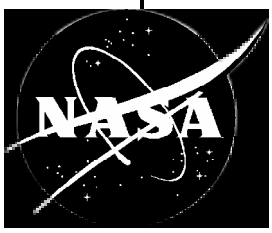
540-096

MISSION OPERATIONS AND DATA SYSTEMS DIRECTORATE

Interface Control Document (ICD) Between the Earth Observing System (EOS) Data and Information System (EOSDIS) Backbone Network (EBnet) and Software Development Facility (SDF)

September 1997



National Aeronautics and Space Administration

Goddard Space Flight Center
Greenbelt, Maryland

Interface Control Document (ICD) Between the Earth Observing System (EOS) Data and Information System (EOSDIS) Backbone Network (EBnet) and Software Development Facility (SDF)

September 1997

Prepared Under Contract NAS5-31500
Task Assignment 46 505

Prepared by:

Chris Garman, Project System Engineer Date
EOSDIS Backbone Network Project

Mission Systems Networks Manager:

Gene G. Knoble, Mission Systems Networks Manager Date
ESDIS Project, Code 423

Division CCB Approval:

Thomas E. Butler, Chairman Date
Nascom CCB, Code 540

Project Approval:

Arthur F. Obenschain, Project Manager Date
ESDIS Project, Code 423

Approved by:

Chris Scolese, Project Manager Date
EOS-AM Project, Code 421

Goddard Space Flight Center
Greenbelt, Maryland

540-096

Preface

This document is under the configuration management of the National Aeronautics and Space Administration (NASA) Communications (Nascom) Division Configuration Control Board (CCB).

Proposed changes to this document shall be submitted to the Nascom CCB, along with supportive material justifying the change. Changes to this document shall be made by Document Change Notice (DCN) or by complete revision.

Questions concerning this document and proposed changes shall be addressed to:

Mission Systems Networks Manager
Code 423
Goddard Space Flight Center
Greenbelt, Maryland 20771

Abstract

This Interface Control Document (ICD) describes interface agreements between the Software Development Facility (SDF) and Earth Observing System (EOS) Data and Information System (EOSDIS) Backbone Network (EBnet).

Keywords: *EBnet, ICD, SDF*

Change Information Page

List of Effective Pages	
Page Number	**Issue**
Signature Page	DCN 001
iv, vi, ix	DCN 001
1-1 and 1-2	DCN 001
2-1 and 2-2	DCN 001
3-2	DCN 001
4-2 and 4-4	DCN 001
5-1	DCN 001
DL-1	DCN 001

Document History			
Document Number	**Status/Issue**	**Publication Date**	**CCR Number**
540-096	DCN 001	September 1997	505-01-36-019

DCN Control Sheet

DCN Number	Date/Time Group (Teletype Only)	Month/ Year	Section(s) Affected	Initials
DCN 0001		September 1997	Front Matter, 1, 2, 3, 4, 5	

Contents

Section 5. Facilities and Maintenance Demarcation

Figures

Abbreviations and Acronyms

Section 1. Introduction

1.1 Authority and Responsibility

The Mission Operations and Data Systems Directorate (MO&DSD) has the authority to implement the Earth Observing System (EOS) Data and Information System (EOSDIS) Backbone Network (EBnet). This authority was granted to MO&DSD by the EOS project under the Office of Mission to Planet Earth (Code Y). The EBnet project is under the National Aeronautics and Space Administration (NASA) Communications (Nascom) Division of the MO&DSD.

Code 540 will provide an operational communications network to support high-speed network communications between EBnet and non-EBnet hosts. The primary responsibility for this project has been assigned to the Nascom Division, Code 540. The system requirements are documented by the references in Section 2.1.

1.2 Purpose

The purpose of the interface between the Software Development Facility (SDF) and EBnet is to support connectivity between the SDF and the EOSDIS Operations Center (EOC) and between the SDF and the Spacecraft Analysis System (SAS). All data flows into or out of the SDF supported by EBnet are considered to be science traffic (for purposes of EBnet Interface Control Documents (ICDs), any traffic type which is not real time is considered to be science traffic).

1.3 Scope

This ICD defines and controls the functions, communications protocol(s), frame formats, and electrical characteristics of the interfaces between EBnet-provided equipment, software, and communications paths and other entities that directly interface with the network. Interfaces provided by Nascom are included in the scope of this document. Interfaces between EBnet users and other systems not provided by Nascom are not within the scope of this document.

1.4 Time Frame

This ICD shall be in effect from the date of the last approval signature.

1.5 Goals and Objectives

The goals of EBnet are to:

a. Implement an operational, integrated, transparent communications system that serves the data communications needs of projects supported by NASA Goddard Space Flight Center (GSFC), and users outside the MO&DSD.

b. Expand using industry standard system solutions while maintaining compatibility with the existing network and user interfaces.

c. Minimize costs for implementation, operation, and maintenance of the network.

d. Minimize life-cycle costs.

e. Maintain high availability by designing with redundancy, and without single points of failure in the Network Backbone, where required.

f. Utilize state-of-the-art technology, utilizing equipment with the best price-performance available commercially.

g. Allow for growth, adaptability to changing requirements, infusion of new technology, and upgraded interfaces throughout the life-cycle.

1.6 Standards Precedence

EBnet will be based on Government, commercial, and international standards. In case of conflict, the following precedence (in descending order) applies:

- This EBnet ICD.
- Government standards.
- Commercial and/or international standards.

1.7 Document Organization

Section 2 contains parent, applicable, and reference documents related to this ICD.

Section 3 details a systems overview of the EBnet, SDF, and the interrelationship.

Section 4 describes the EBnet system architecture and identifies the standards supported at each level of the International Organization for Standardization (ISO) model.

Section 5 describes the facilities and maintenance demarcation.

A list of abbreviations and acronyms is provided at the end of the document.

Section 2. Related Documentation

2.1 Parent Documents

[1] *Earth Observing System AM-1 Detailed Mission Requirements*, Goddard Space Flight Center (GSFC), 505-10-33, November 1996

[2] *Earth Science Data Information System (ESDIS) Project Level 2 Requirements Volume 6, EOSDIS Backbone Network (EBnet) Requirements*, Goddard Space Flight Center (GSFC) 505-10-01-6, Revision A, December 1996

[3] *Earth Observing System (EOS) Data and Information System (EOSDIS) Backbone Network (EBnet) Interface Requirements Document (IRD)*, September 1997

[4] Reserved

2.2 Applicable Documents

[5] *Electrical Characteristics of Balanced Voltage Digital Interface Circuits*, Electronic Industries Association (EIA) 422-A, December 1978

[6] *General-Purpose 37-Position and 9-Position Interface for Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange*, EIA 449, November 1977

[7] *Internet Protocol (IP): DARPA Internet Program Protocol Specification*, Request for Comment (RFC) 791, September 1981

[8] *The Point-to-Point Protocol (PPP)*, RFC 1661, July 1995

[9] *An Ethernet Address Resolution Protocol or Converting Network Protocol Addresses to 48-bit Ethernet Addresses for Transmission on Ethernet Hardware*, RFC 826, November 1982

[10] *Internet Control Message Protocol*, RFC 792, September 1981

[11] *Routing Information Protocol (RIP)*, RFC 1058

[12] *Open Shortest Path First (OSPF)*, RFC 1247

[13] *Internet Group Multicast Protocol (IGMP)*, RFC 1112

[14] *On the Assignment of Subnet Numbers*, RFC 1219

[15] *Simple Network Management Protocol (SNMP)*, RFC 1157

[16] *Address Resolution Protocol (ARP)*, RFC 826

[17] *A Reverse Address Resolution Protocol (RARP)*, RFC 903

[18] *Internet Protocol on Ethernet Networks*, RFC 894

[19] *Transmission of IP over FDDI*, RFC 1188

[20] *Structure of Management Information*, RFC 1155

[21] *Management Information Base - II*, RFC 1213

[22] *Transmission Control Protocol*, RFC 793

[23] *Telnet Protocol*, RFCs 854 & 855

[24] *File Transfer Protocol*, RFC 959

[25] International Organization for Standardization (ISO) 9314-1, *FDDI Physical Layer Protocol (PHY)*

[26] ISO 9314-2, *FDDI Media Access Control (MAC) Protocol*

[27] ISO 9314-3, *FDDI Physical Layer Medium Dependent (PMD)*

[28] ISO 8802-2, *Logical Link Control (LLC)*

[29] ISO 8802-3, *Carrier-Sense Multiple-Access with Collision Detection (CSMA/CD) Media Access Control (MAC) - Ethernet version 2*

[30] Institute of Electrical and Electronic Engineers (IEEE) 802.3 *10Base-T (twisted pair)*

[31] IEEE *10Base5 (thick ethernet)*

[32] International Telegraph and Telephone Consultative Committee (CCITT) *V.35*

2.3 Reference Documents

[33] *NASA Communications (Nascom) Access Protection Policy and Guidelines*, 541-107, Revision 3, GSFC, November 1995

[34] *NASA Communications System Acquisition and Management*, NASA Management Instruction (NMI) 2520.1D, National Aeronautics and Space Administration (NASA), November 18, 1991

[35] *Nascom IONET Users Guide*, 541-225, Revision 1, April 1996

[36] *Interface Control Document Between EOSDIS Core System (ECS) and the Spacecraft Software Development and Validation Facilities (SDVF)*, 209-CD-025-001, Hughes Information Technology Corporation, October 1995

Section 3. Systems Overview

3.1 EBnet General System Description

The EBnet provides wide-area communications circuits and facilities between and among various EOS Ground System (EGS) elements to support mission operations and to transport mission data between EOSDIS elements. The relationship of EBnet to other elements supporting EOS is shown in Figure 3-1. EBnet is responsible for transporting spacecraft command, control, and science data nationwide on a continuous basis, 24 hours a day, 7 days a week. The EBnet capability to transport these diverse types of data is implemented as two distinct subnetworks referred to as "real-time" and "science" networks. The real-time network transports mission-critical data related to the health and safety of on-orbit space systems and raw science telemetry as well as pre-launch testing and launch support. This highly redundant network provides an operational availability of 0.9998 with a Mean Time to Restore Service (MTTRS) of 1 minute. The science network transports data collected from spacecraft instruments and various levels of processed science data including expedited data sets, production data sets, and rate-buffered science data. The science network provides an operational availability of 0.98 with a MTTRS of 4 hours.

EBnet provides three options for accessing the Internet Protocol (IP)-based EBnet transport service: Local Area Network (LAN) Ethernet, LAN Fiber Distributed Data Interface (FDDI), and Wide Area Network (WAN) carrier service. Figure 3-2 shows an example of each of these types of interface/demarcation points to EBnet users. This ICD describes the EBnet/SDF interface which uses both LAN and WAN interface types.

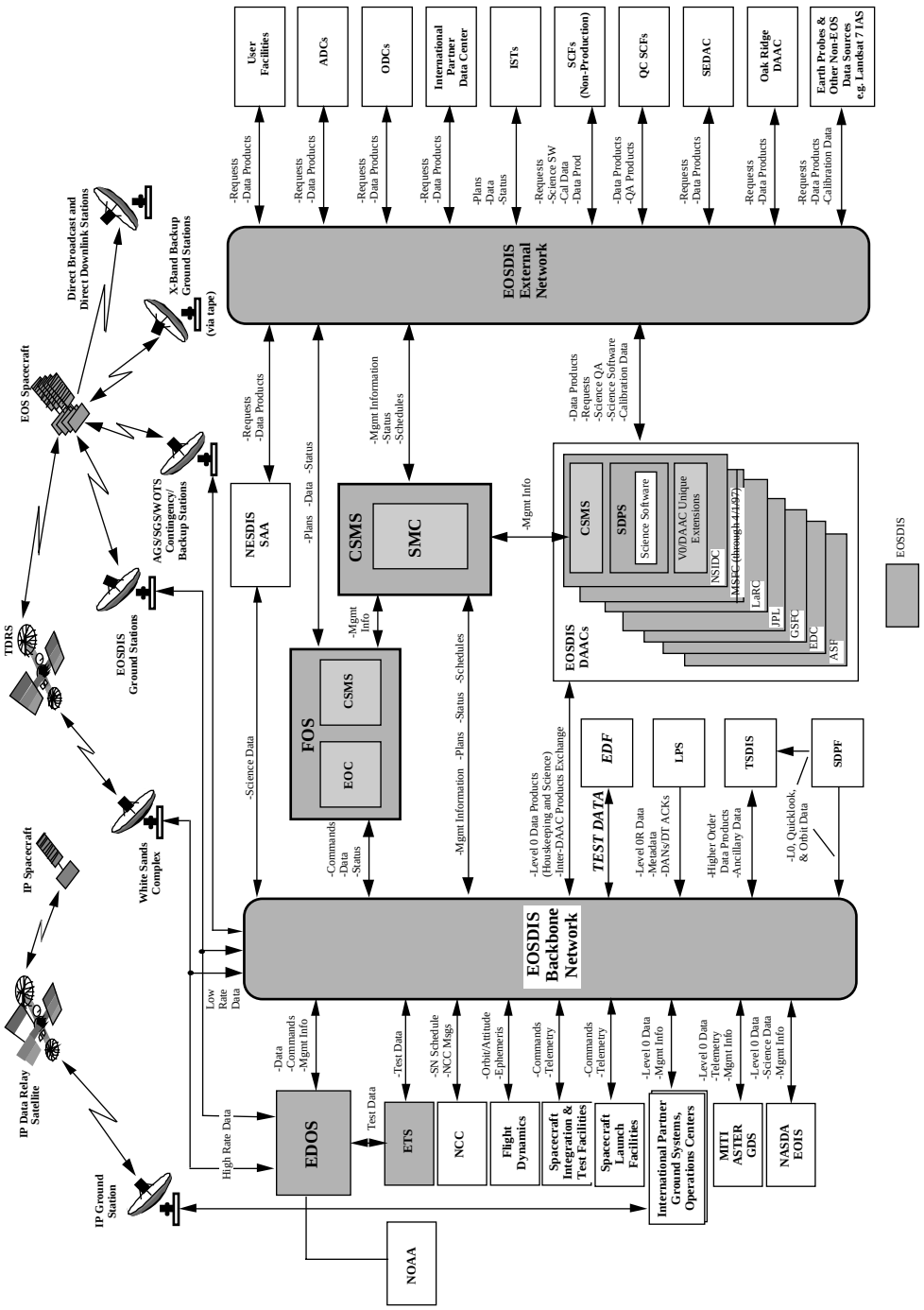


Figure 3-1. EOS Ground System

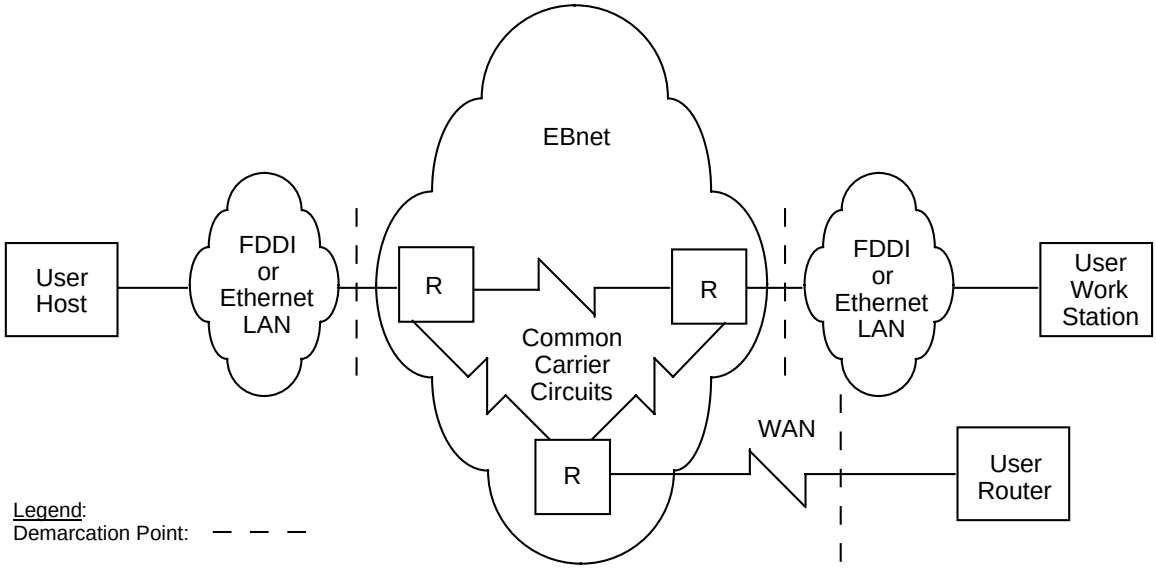


Figure 3-2. EBnet Demarcations

Sustaining engineering, preventive and remedial maintenance, and network monitoring services are provided for EBnet equipment, to ensure that EBnet keeps pace with technology and standards, and provides continuous service. The official point of contact for EBnet operational status is the Nascom Communications Manager (COMMGR) (301-286-6141). Users who detect a network problem are urged to immediately report it to the COMMGR. The COMMGR may also provide users with limited information about maintenance and status actions. Refer to the Nascom Internet Protocol (IP) Operational Network (IONET) User Guide (541-225) for information regarding user connections, security guidelines, and maintenance information.

3.2 SDF Description

The SDF is located at the spacecraft vendor facility in Valley Forge, PA and interfaces with the EOC via the ECS developed Instrument Support Terminal (IST) Toolkit. SDF is used to develop the flight software for the AM-1 spacecraft. During the early stages of the mission, flight software maintenance is also performed at the SDF. The flight software and flight software table updates are generated at the SDF and provided to the EOC via the IST for subsequent transmission to the spacecraft. The flight software dump as received from the spacecraft at the EOS Operations Center (EOC) is transmitted via the IST to the SDF for detail analysis.

During the AM-1 mission, the SDVF function is first performed by the SDF located at the contractor's facilities at Valley Forge, PA (VFPA). While at VFPA, the SDF requires communication with the EOC at GSFC, more specifically, with the SAS after it has been installed in the EOC.

3.3 Relationship Between EBnet and SDF

EBnet provides the LAN interfaces and the WAN necessary to provide a communication path between the SDF (at each of its two locations) and the EOC. Functionally, this interface may be viewed as depicted in Figure 3-3.

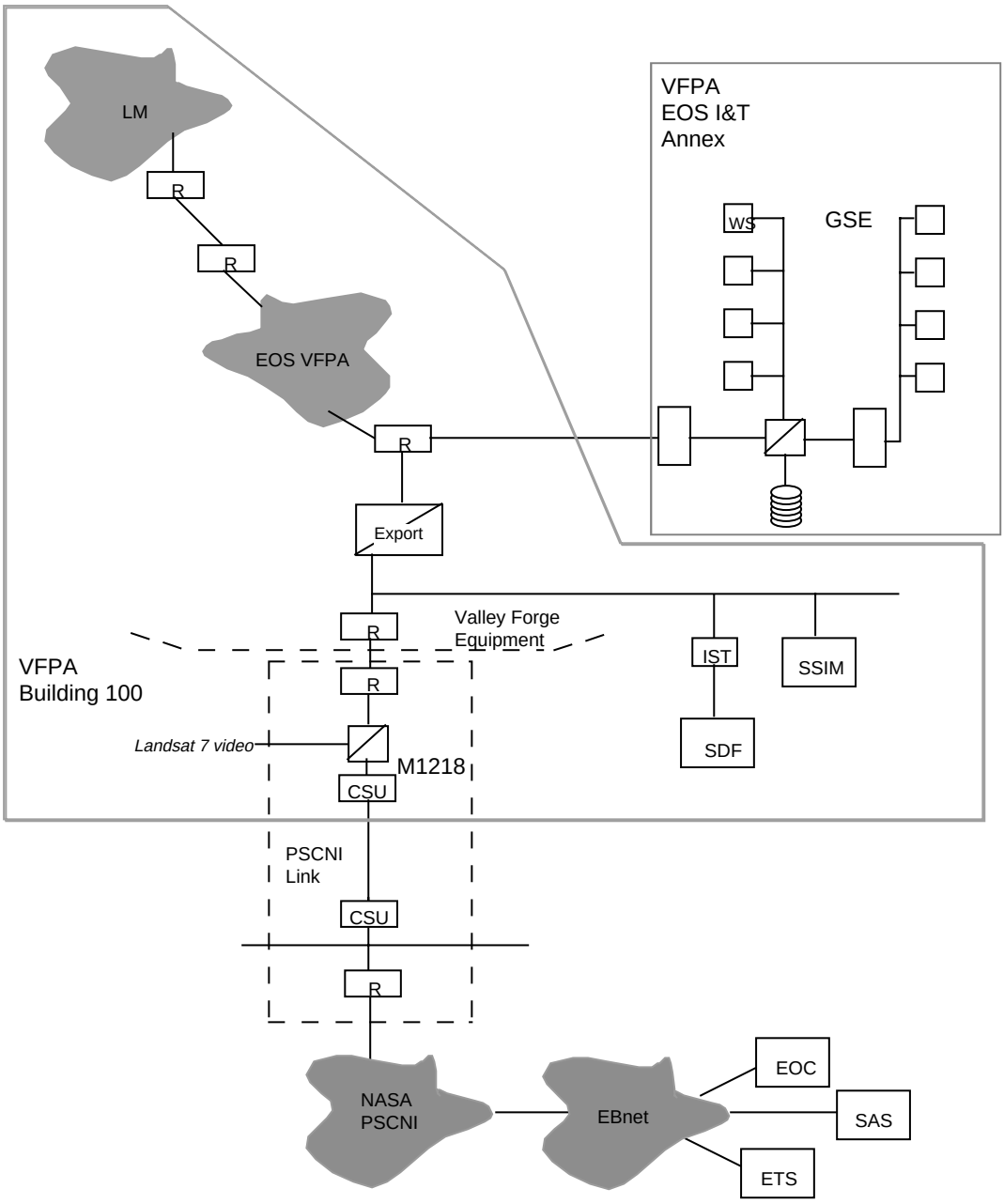


Figure 3-3. EOC/SDF Interface Overview (Reflects IP Interfaces Only)

Section 4. Interface Detailed Design

4.1 Interface Design Overview

The EBnet/SDF interface design is based on the requirement to transport software data between EOC (the SAS) and the SDF. Initially, the EBnet design provides the WAN segment between the EOC and SDF utilizing the resources of the Program Support Communication Network-Internet (PSCNI). The SDF local interface may be provided in association with an IST that is itself an element of a spacecraft vendor controlled isolation net. Figure 4-1 represents the interface with the SDF located at VFPA.

4.2 Design Assumptions

a. The only type of interface that will be required is IP (both for LAN and WAN segments).

b. The data rate to be supported will be 56 kilobits per second (kbps) for both incoming and outgoing data.

c. The SDF will be located at the spacecraft vendor's facilities at VFPA.

d. The PSCNI backbone will be available for transport of the WAN segment of the SDF interface.

4.3 Data Interface Design

The following information is known about the design of the data interface for the SDF at VFPA. Routers provide the data communication interfaces. The protocols for each layer are described in the following paragraphs.

The following sections detail the standards that will be supported at each level of the ISO seven-layer model.

4.3.1 ISO Layer One Interface Control (Physical Layer)

EBnet will support the following physical layer connections:

a. Institute of Electrical and Electronic Engineers (IEEE) 802.3 10BaseT (unshielded twisted pair) with RJ45 connectors.

b. IEEE 10Base5 (thick ethernet, RG-8 coax, 50 ohm impedance) with 15-pin connector.

c. ISO 9314-1, FDDI Physical Layer Protocol (PHY).

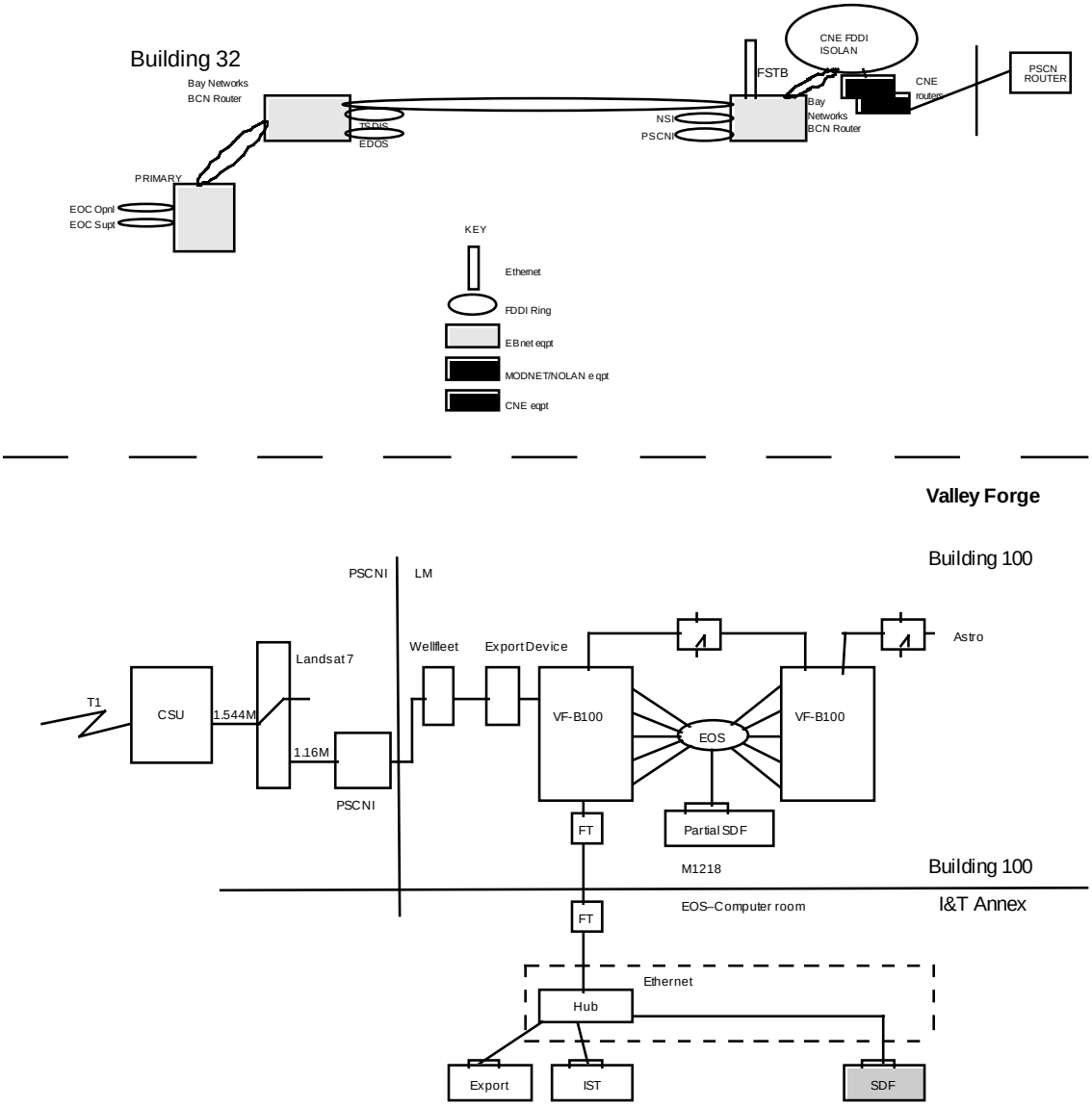


Figure 4-1. Interface for SDF Located at Valley Forge

d. ISO 9314-3, FDDI Physical Layer Medium Dependent (PMD).

e. CCITT V.35 for speeds above 19.2 kbps.

f. Electronic Industries Association (EIA) RS-422 for speeds above 19.2 kbps.

4.3.2 ISO Layer Two Interface Control (Data Link Layer)

EBnet will support the following data link layer protocols:

a. ISO 802.2, Logical Link Control (LLC).

b. ISO 8802-3, Carrier-Sense Multiple-Access with Collision Detection (CSMA/CD) Media Access Control (MAC) - Ethernet Version 2.0 is supported.

c. ISO 9314-2, FDDI MAC Protocol.

d. Point-to-Point Protocol (PPP) [8].

e. Cisco Proprietary High-level Data Link Control (HDLC).

4.3.3 ISO Layer Three Interface Control (Network Layer)

EBnet will support the following network layer protocols:

a. RFC 791, Internet Protocol Version 4.0.

b. RFC 1157, Simple Network Management Protocol (SNMP).

c. RFC 826, Address Resolution Protocol (ARP).

d. RFC 903, A Reverse Address Resolution Protocol (RARP).

e. RFC 1058, Routing Information Protocol (RIP).

f. RFC 1247, Open Shortest Path First (OSPF).

4.3.4 ISO Layer Four Interface Control (Transport Layer)

EBnet will support transparent communication at the transport layer.

4.3.5 ISO Layer Five Interface Control (Session Layer)

EBnet will support transparent communication at the session layer.

4.3.6 ISO Layer Six Interface Control (Presentation Layer)

EBnet will support transparent communication at the presentation layer.

4.3.7 ISO Layer Seven Interface Control (Application Layer)

EBnet will support transparent communication at the application layer.

4.3.8 Network/Station Management Protocols

EBnet shall support, at a minimum, the following management protocols:

a. SNMP.

b. FDDI Station Management (SMT) 6.2 or higher.

4.4 Routing and Addressing Guidelines

EBnet will be internetworked by routers and switches which will be configured to support only the IP, and will provide isolation for separate networks. Cisco 7513 and Bay Network BCN routers have been chosen to provide network access to users.

EBnet will utilize standard IP addressing conventions. SDF will utilize a pre-assigned address from an existing block of IP addresses at VFPA.

4.5 Data Flow Requirements

The EBnet/SDF interface shall meet the following performance specifications:

a. Data rate: 56 kbps.

b. Restoral: Since this is not a real-time interface, the EBnet system design will support a MTTRS of 4 hours.

At the VFPA facility the SDF while connected to the EOS Isolation network will comply with the Lockheed Martin (LM) Network Security requirements. This policy is enforced by the use of a Firewall (router/filter/EOS-export) which blocks all traffic between the GSFC EBnet node and the protected LM/EOS network, but still permits users on the protected EOS network to carry out basic File Transfer Protocol (FTP)/Telnet operations.

4.6 Equipment List

EBnet will provide the following equipment to support this interface:

a. Routers: Cisco (Model 7513).

b. Router: Bay Networks (Model BCN).

Section 5. Facilities and Maintenance Demarcation

5.1 Equipment Location

EBnet will interface to the router located in Building 100 Integration and Test (I&T) Annex at VFPA. EBnet equipment will be located in Building 32, Room C210H and Building 1, Room 53.

5.2 Maintenance Demarcation

The demarcation point of EBnet maintenance is the connection at GSFC PSCNI router. The user is responsible for cables to the PSCNI demarcation on the VFPA side.

Abbreviations and Acronyms

ARP	Address Resolution Protocol
CCB	Configuration Control Board
CCITT	International Telegraph and Telephone Consultative Committee
COMMGR	Communications Manager
CSMA/CD	Carrier-Sense Multiple-Access with Collision Detection
DCN	Document Change Notice
EBnet	EOSDIS Backbone Network
EGS	EOS Ground System
EIA	Electronic Industries Association
EOC	EOS Operations Center
EOS	Earth Observing System
EOSDIS	Earth Observing System Data and Information System
FDDI	Fiber Distributed Data Interface
FTP	File Transfer Protocol
GSFC	Goddard Space Flight Center
ICD	Interface Control Document
IEEE	Institute of Electrical and Electronic Engineers
IONET	IP Operational Network
IP	Internet Protocol
IRD	Interface Requirements Document
ISO	International Organization for Standardization
IST	Instrument Support Terminal
LAN	Local Area Network
LLC	Logical Link Control
LM	Lockheed Martin
MAC	Media Access Control

MO&DSD	Mission Operations and Data Systems Directorate
MTTRS	Mean Time to Restore Service
NASA	National Aeronautics and Space Administration
Nascom	NASA Communications
NMI	NASA Management Instruction
OSPF	Open Shortest Path First
PHY	Physical Layer Protocol
PMD	Physical Layer Medium Dependent
PPP	Point-to-Point Protocol
RARP	Reverse Address Resolution Protocol
RIP	Routing Information Protocol
SAS	Spacecraft Analysis System
SDF	Software Development Facility
SMT	Station Management
SNMP	Simple Network Management Protocol
WAN	Wide Area Network